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Vol.				Vol.			
1.	3	numbers,	1928.	13.	4	numbers,	1942.
2.	4	,,	1929.	14.	4	,,	1943.
3.	3	,,	1930 (none).	15.	4	,,	1944.
4.	4	,,	1931.	16.	4	,,	1945.
5.	2	,,	1932 (none of No. 2).	17.	4	,,	1946 (none of No. 1).
6.	2	,,	1933.	18.	4	,,	1947 (none of No. 1).
7.	1	,,	1934.	19.	4	,,	1948 (Nos. 3 and 4 form a double issue).
8.	4	,,	1935-7 (none of No. 4).				
9.	4	,,	1938 (none of Nos. 2, 3 and 4).	20.	4	,,	1949.
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12.	4	,,	1941 (none of Nos. 1 and 2).	22.	1	,,	1951.

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ISSUES OF AGRICULTURAL CIRCULAR

NUMBERS and year of issue of the "Agricultural Circular" :—

Vol. 1, 1920, 12 numbers. Vol. 4, 1923, 1 number.
2, 1921, 5 ,, 5, 1924-5, 2 numbers.
3, 1922, 4 ,,

As number 4 of Vol. 3 was printed as "Volume 4" and number 1 of Vol. 4 as "Volume 5" it would appear from an inspection of a complete set that Volume 4 comprised only a number 4 and that there were two issues of Volume 5, No. 1.

ANNUAL BULLETINS

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—EDITOR

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EDITORIAL . . .

MECHANISATION OF AGRICULTURE

In a previous editorial in this *Journal* on the subject of mechanisation of agriculture as an introduction to studies then commencing at Koronivia, the writer drew attention to the importance of mechanisation in the development of the Colony's agriculture. At the same time it was pointed out, on the score of cost, that all farmers could not hope to possess tractors and tractor implements ; moreover, there were limitations to their use. In many parts of the Colony land is too steep and broken to permit the use of tractor equipment and for many tropical crops specialised equipment for planting and harvesting has yet to be developed.

In an article in this issue of the *Journal* the Agronomist refers to the investigations on mechanisation that have been undertaken over the past two years at Koronivia. The conclusions reached so far are that, whereas it is unlikely that " baby " tractors and equipment will compete economically and successfully with bullocks, in general farming in Fiji medium-powered row crop tractors on rubber tyres appear to have a firm place in local farming practice. The versatility of several modern type medium-powered tractors such as the Ferguson, Fordson and David Brown, with a wide range of associated and easily interchangeable equipment, has been amply demonstrated at Koronivia and elsewhere in the Colony. The capital outlay is much lower than that required for the more expensive higher powered track types and running and maintenance costs are reasonable. Above all it has been clearly shown that these medium-powered tractors on rubber tyres, if used at the proper time, can do most of the work it was formerly believed could be undertaken only by a heavier type Crawler.

Land should be broken and cultivated at the right moisture content, otherwise soil structure may be lost. Loss of soil structure leads to compacting and poor drainage and, in consequence, lowered fertility. There is evidence to show that the use of heavy track type equipment at the wrong time has, down the years, compacted the soil on certain arable areas with interference to drainage.

Although " baby " tractors will have a limited use in Fiji, in general farming it is likely that more use will be found for them in the future for vegetable raising and general horticultural work ; in fact, they were developed for this specialised purpose, not as small models of larger types for peasant farmers' pockets. Present evidence suggests that the Ransome MG5 and the small-powered Rotary Hoe will give good service in the Colony.

Heavy equipment will be required for the clearing of bushland and the breaking in of virgin country but, on the whole, most of the general farming, both in the cane and pastoral areas, can be carried out by the farmer or co-operative group with medium-powered row crop tractors on rubber wheels.

Studies on mechanisation are continuing at Koronivia and Sigatoka with particular reference to the planting and harvesting of grain and native root crops. This work is of first importance in the development and expansion of agriculture in the Colony.

—W.J.B.

AGRICULTURE . . .

TRACTORS IN FIJI

BY R. R. MASON, B.Sc. (AGRIC. LONDON), N.D.A., DIP. AGRIC. (CANTAB.),
AGRICULTURAL OFFICER

A previous article in this *Journal* by Mr. ffrench-Mullen discussed the effect of the dollar shortage on the importation of American crawler tractors which were popular before the war, and suggested that cheaper British wheeled types might prove suitable for Fiji conditions. A brief review of such types was given, with details of those which the Agricultural Advisory Council had recommended for purchase and trial.

Five tractors were imported, and arrived during 1949. They were put to work on the Principal Agricultural Station at Koronivia (where a sixth was already in use) in order to compare their relative merits, and more particularly the merits of the various classes of machines which they represented. The notable success of the light pneumatic-tyred rowcrop tractors has helped to popularise this class and bring about the big change in tractor numbers which has recently occurred.

In the last three years, tractor numbers have increased very rapidly from a total of about 60 to over two hundred. Nearly all of the 60 were diesel-engined crawlers, while the total at 31st March, 1952, is made up as follows:—

Horticultural—		
B.M.B.	2	
Ransomes	5	
		7
Wheeled—		
David Brown	1	
Farmall	5	
Ferguson	135	
Fordson	14	
		155
Crawler—		
Bristol " 20 "	2	
Caterpillar	42	
Fordson " County "	3	
Fowler	8	
International	3	
		58

These figures, which may contain some errors, are exclusive of tractors used on non-agricultural work such as timber hauling.

While the group of tractors was under trial at Koronivia, their relative merits under Fiji conditions were shown up by practical work, and advice was given to interested enquirers. Briefly, the baby 2-wheeled B.M.B " Plowmate " has proved hard to handle, and the tool bar and implements have given evidence of weakness. On the other hand, another small horticultural tractor, the Ransomes " MG 5 ", has proved very useful and has given negligible trouble ; but owing to its tracks its cost is comparatively high. The Ferguson has become very popular owing to its comparatively low running cost and its versatility. Considerable trouble has been experienced with the Bristol " 20 ", both mechanically and when ploughing ; for general conditions the wide-track model which was recently put on the market would be more stable. The David Brown " Cropmaster 65 " has a little more power than the last two, but the absence of an agent in Fiji and the lack of facilities for servicing have precluded its becoming popular. In addition to these tractors, a Fordson "Major" has been in use on the station for three years. It is a powerful tractor, especially when fitted with half-tracks ; however its fuel consumption has proved to be high in relation to performance.

Three public demonstrations were held in 1951. The first was at Koronivia on July 11th. In addition to the B.M.B., Ransomes, Ferguson, David Brown, Bristol and the station's Fordson " Major ", a Fordson " County " on loan from the agents was shown. To demonstrate the large range of Ferguson implements, the agents lent a second Ferguson tractor. A large and representative gathering attended, and the weather was kind. Trailed implements were used and changed every hour. For example, the David Brown was ploughing for

the first hour ; then it operated an Atkinson Manure Spreader (spreading coral sand), and then an International semi-mounted mower. The total range of implements shown included disc and mouldboard ploughs, disc harrows, cultivators, mowers, hoes, and ridgers, a mole plough, a swamp plough turning an 18 inch furrow, a sack lifter, and a saw bench. A brief description of each of the different tractors and implements was given, and there were some interesting discussions. In the afternoon a more direct comparison of the various tractors was provided by having them all ploughing, and later ridging, in the same field at the same time. The accompanying photographs were taken at this time and show some of the different machines and part of the crowd.

The second demonstration was held in the Tailevu dairying district on 28th August, Mr. L. Hunt very kindly making his land available. The attendance was again large, and the weather good, so that the full programme could be carried out as planned. Emphasis was placed on grassland work and pasture rejuvenation. A small area of weedy but close-grazed Carpet grass pasture had been ploughed up and planted to Para grass in the previous fortnight, in order to show the effects on the finished job of four very different ploughs. These four were a disc plough, a semi-digger, a swamp plough turning a wide flat furrow, and a Rome heavy scalloped disc harrow used twice. A long dry spell followed the planting and it is now clear that the mouldboard ploughs have given the better stands of Para grass. On the day, old grass was ploughed up in various ways and then worked down by disc harrows. Disc, tine, and chain harrows were used to rejuvenate old Para and Carpet grass pastures. A manure spreader, various mowers, mole ploughs and a subsoiler were shown, and a demonstration given of digging a shallow drain using a trailing and a tractor-mounted grader. The tractors demonstrated were Fordsons, Fergusons, a David Brown, and a Caterpillar D2 ; each worked for ten minutes or so, one after another in continuous succession. A Land Rover was also demonstrated pulling first disc harrows and then a mower. The total number of implements shown was just under thirty, of which a number were lent by neighbouring farmers.

The final demonstration, on 30th August, was of horticultural tractors and was held at Lodoni ; it was remarkable chiefly for the lack of interest it aroused. It is apparent that only rarely will these " babies " compete economically with bullocks in Fiji. The smaller types are of very limited use ; the larger are not very much cheaper than medium powered tractors, with which a man can earn extra money by contract work. The B.M.B. Plowmate, Ransome M.G. 5, Sam's Gardener, and Allen Scythe were shown with their associated implements, in the grounds of the Ratu Kadavulevu School. A not uncommon fallacy is that a small farmer or peasant farmer only needs a small machine ; but while it is true that speed of work is of comparatively little importance, depth of work (of ploughing, etc.) is important and cannot be reduced.

While heavy crawlers are still required for breaking in rough country, it is apparent that these medium powered tractors can cope with nearly all other normal work ; mole draining is (possibly) the only exception, but even this can be done by the use of a winch. Their much lower capital cost results in lower operating costs ; and their much greater versatility enables cropping to be more completely mechanised. Some of the methods being evolved at Koronivia may be of interest. For example, instead of growing kumalas in hills, with hand implements, the land is ridged at 30" ; the actual planting of the cuttings is by hand, but intercultivations are done 2 or 3 times with a spring tine cultivator and once with a subsoiler. Lifting is satisfactorily carried out by a potato plough, after dragging off the tops with a cultivator. Tapioca is grown in the same way, experiments having shown that under these conditions the optimum spacing of the cuttings is 15" apart. This close spacing induces a dense canopy which controls weed growth when the tractor intercultivation is no longer possible. Sugar cane, a very important crop, is on the whole the most mechanised crop in Fiji, although harvesting is still done by hand. For inter-

cultivation a high-clearance or a narrow tractor is desirable. When intending to straddle a row with a tractor and light mounted cultivator with a central steerage fin, an extra fin should be obtained and one fin mounted on each side of the tool bar, leaving the centre clear ; by this means work can be done right up to the cane in the row. An idea for ensuring parallel drills, applicable to a row crop tractor and mounted tool bar, is to set the wheels to the row-width (say 54") and to mount two ridging bodies at this distance apart. On each run after the first, the tractor is driven with one wheel in the last drill, in order to complete the old drill and half form a new one. A cane-planter which has operated successfully in Australia, is now available here, the sets being fed into the machine by hand.

The possibilities of mechanising rice-growing are under investigation at the present time at Koronivia. Preliminary results suggest that in the wet zone there is no great benefit from transplanting ; the use of a corn drill on well drained land has resulted in good crops, and the cost has been vastly reduced. Attention is now being given to harvesting and to weed control by the use of a steerage hoe. For work in swamp conditions heavy tractors are useless. The Ferguson fitted with double rear wheels and the Ransomes MG 5 have so far shown great promise.

To conclude, mechanisation is progressing rapidly in Fiji, and will undoubtedly continue to do so. The versatility and economy of medium-powered row-crop tractors on rubber tyres are the cause of their gaining popularity. The efficiency of the servicing facilities provided by the local agents must be mentioned as a matter of prime importance in a country so far from the factories. Finally, efficiency is now being limited not by the design or the supply of tractors but by the general lack of skill and of training of the drivers.

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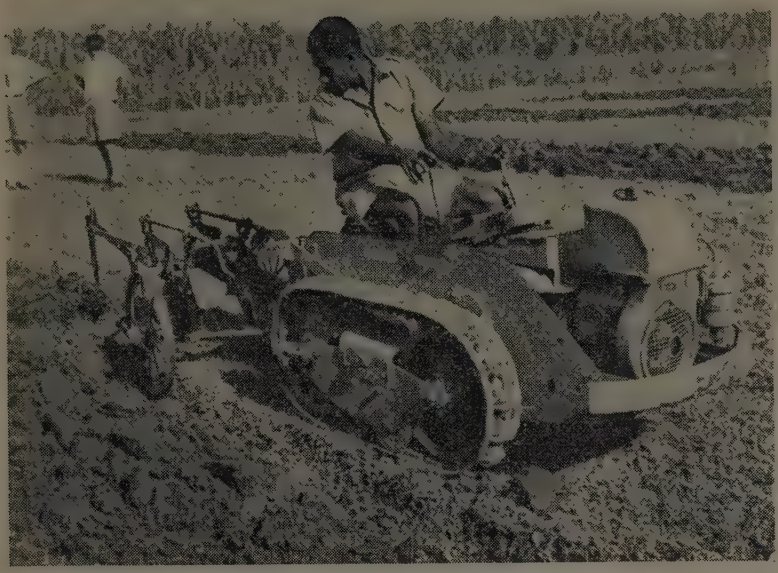
Ferguson (TE-A-20) and two-furrow mounted disc plough.

A group of spectators at the Machinery demonstration at Koronivia.

Fordson Major, pulling an International "GL 70" 3 disc plough.



Ransomes " MG 5 " and single furrow mould board plough.

Bristol " 20 " and mounted two-furrow mould board plough.

RANGE LAND FIRING IN FIJI

BY C. E. WHITEHEAD, SOIL CONSERVATION OFFICER

As an opening to a campaign against uncontrolled grass firing in Fiji, there will shortly be made within the Colony a wide distribution of a series of posters which have been designed to sharply focus public attention to the serious problem of fire control in the Western range land of Viti Levu, and the range land of the sister island, Vanua Levu.

The time has long come for citizens to change their apathy towards the uncontrolled burning of the Colony's land to one of deep concern, if the "Scorched Earth policy" which is applied annually to the Western half of Viti Levu is to be halted in time to prevent the final ruination of vast areas of range land, which have already deteriorated so badly from the disastrous affects of searing fires, which have swept across the country so frequently during past years.

What are the causes of these fires which can be seen each dry season sweeping from range to range like a maddened "Tevoro"? They are:—

the carelessly handled firestick ;
the uncontrolled burning of dry pastures just prior to expected storms for the production of green shoots for goats and stock;
the clearing of areas for wild yams ;
the wilful abandonment of small fires started to smoke out wild pigs from reeds ;
the careless clearing of teitei areas by fire ;
the lack of control exercised on large holdings in the "renovation" of pastures by fire ;
the natural agents of lightning and light rays in focus through quartz crystals or even glass bottles ;
Arson—intentional or otherwise.

The price of matches is now so reasonable that matches are within the reach of every individual within the Colony, and there is absolutely no excuse for the obsolete practice of conveying firesticks around. Use of firesticks should be strictly prohibited.

The use of fire for "flushing" wild pigs from reed banks, and for preparing land for wild yam gathering has proved so destructive that the benefit derived by its use is far out of proportion to the damage it does. These practices should be abolished.

Careless clearing of land for new teitei areas and the firing of pastures without regard to the ultimate control of the fire are the chief causes of destructive fires in range lands.

Lightning can, and does occationally cause range land fires ; likewise the natural focus of the sun's rays through a piece of surface quartz or even an empty bottle will start a fire if the material is tinder-dry. However, the percentage of fires started by these agents is so small as to be negligible.

The brainless motorist who throws a cigarette butt from his car into a tinder-dry wall of roadside grass while travelling through range land country in the dry season, is one of the worst types of citizen a country can contain. Unfortunately such a motorist is five to ten miles away before his handiwork suddenly blossoms into an unholy yellow rose of flame.

What are the effects of firing on range lands? Briefly, fire destroys trees—grass—and soil.

The range land of Fiji is a typical open Savannah type of but light fertility supporting a sparse population of trees, which are a vital link in the maintenance of Nature's balance of these lands, and are placed by Nature in the most stragetic position—the watersheds. These trees shield the soil on such steep slopes against the storm rain's battering blows which are cushioned by their boughs, while their deep tap roots and maze of subsidiary surface roots bind and hold the soil together, securely anchored against the ever present pull of gravity, even when it is absolutely saturated in the wet season.

When these watersheds are swept by frequent fires the younger trees soon die out. In time even the older stand of trees succumb with perhaps the exception of one or two old gnarled veterans. Every one in the Colony is familiar with the isolated remnants of what was once a healthy colony of Nokonoko (*Casuarina equisetifolia*) trees.

Nature has occasionally displayed her marvellous power of regeneration in the vicinity of those veterans where fire, by some benevolent design or accident, has not passed by for some three or four seasons. In such areas young seedling trees of healthy Nokonoko hopefully raise their tender branches to the sky. Thus, there is proof that if a timely stop is put to persistent firing a natural reafforestation will take place on these watersheds.

With the trees destroyed by fire and the binding roots decayed the soil is unprotected from the violent storms, and when saturation occurs gravity more often than not exceeds the " angle of repose " of the soil which, in a large mass, avalanches down to choke creeks, block roads, railways, and smother rich crop lands.

The destruction by fire of the vegetable cover which is the grass with its attendant dead litter, exposes the soil to strong winds, scorching sun, and pelting rains. The wind more often than not blows the residue of light ash away, and, if very strong, the fine soil particles as well. The scorching sun creates terrific soil temperatures which rapidly oxidize out the organic content of the vital few inches of top soil. Such soil bared, and deprived of its humic content, cannot absorb and hold pelting rain which soon seals off the soil pores (air spaces between particles) at the surface, and with a velocity proportionate to the slope of the land, runs towards the first creek or gully, carrying with it all those fine soil particles which were formerly held in a sponge-like structure of a once healthy soil.

Nature now strives to clothe her nakedness with species of plants which are most times inferior to the trees and grasses which originally grew, but which will grow on the now impoverished soil. If, however, there is no respite to these scorching fires, the rate of depletion accelerates until there comes a day when all surface soil with its plant food is gone, and a barren dead earth looks to the heavens in mute protest at the stupidity of man—Vaisigasiga land—earth to the sky.

What of the creeks and rivers and the coastal flats far removed from the despoiled range land? Creeks that once carried crystal clear water gently reticulated from a range land clothed in trees and grass, now receive from a barren marginal waste, a swirling deluge of earth and gravel-laden water which deposits its burden as choking shingle and sand bars ;—bars that cause vicious bank cutting currents to tear away countless acres of rich delta land :—bars that in time of heavy rains, bank up and divert raging torrents of water over the very banks of the rivers on to man's mosaic of effort—the fields of carefully tendered crops.

Until such time as a halt is put to the irresponsible firing of the rolling marginal range lands of Western Viti Levu and Vanua Levu, no headway can be made to control run-off and erosion, the proper pasture management of grazing lands, and the reafforestation of critically exposed water sheds.

While condemning out of hand the indiscriminate burning of range land, this Department has not overlooked the value of fire as a tool in the correct utilization of land—or for the preparation of land for correct utilization. This fire is " Controlled " fire ; a servant—not a master.

* " Controlled fire can best be defined as the planned application and confinement of fire to a preselected area for use in :—

initial conversion of scrub or bush lands into established pastures ;

burning off dead matter (overburden) rank growth and promoting new shooting ;

burning fire breaks and destroying rubbish before dangerous accumulation of inflammable materials occur."

Experience in pasture management in the veldt country of South Africa shows firing of certain types of veldt to be an essential part of maintenance in the pasture of those lands. However, the application of fire and the time of firing has been carefully studied. Thus, some veldt lands will not tolerate fire —their pastures deteriorate, and yet other types benefit from firing once every year or so in the early part of the dry season.

* California Agriculture.

In Fiji fire has played no mean part in the initial conversion of jungle into farm lands and its correct application may possibly be part of the proper management of range land pastures. Until such time as the lush rank growth of summer is controlled by correct sub-division, stocking rates and conversion of excess grass into meadow hay by the use of tractor or horse mowers (where possible), fire will be required to remove the bulk of this growth which by November has become a dense dead mat of overburden which is of no use to stock and which inhibits the growth of new grass following on the first rains.

It is felt that on larger holdings, better use of sub-division, stock and machinery could be made to keep pastures from becoming rank. The advance of undesirable weeds into pasture lands through overstocking, for example, can only be temporarily halted by a heavy burn which in the final run does more harm than good.

It seems desirable that the use of fire in Fiji in the management of grazing and teitei land be brought under Government control, and that permits to burn be issued for burning at a determined time of the year. This should be at a time when grass lands are not so tinder dry that the fire becomes a roaring inferno, or when the season is at so late that the grass has not a chance to grow a protective covering over the soil before meeting the onslaught of the pounding downpours of the first violent November storms.

Whatever the arrangement is to be, fire *must* be confined to the area to be burnt and not allowed to go ravaging over the hills. This is an undertaking of no mean proportion. The Americans with customary enthusiasm have made a science of controlled range land burning, yet despite their organised teams of firemen, aided by every modern firefighting appliances, one planned fire in every six gets away to become a " wildfire " to destroy new forest plantings, reserve fields of meadow hay, etc.

Finally summing up, fire as we know it in our range land of the Colony, is uncontrolled fire—the Enemy within, aided by a small but deadly Fifth Column—those who spread it. Each time a citizen sees a distant hill-line ablaze he can truthfully say, " There goes part of my heritage—Up in smoke."

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FIBRE CROPS

In view of current interest in and the importance of fibre crops in world economy, the following notes on the principal fibre crops which has been prepared by the Agricultural Officer Western (Mr. A. Carver) will be of interest to readers. The Department is actively engaged in the introduction of new fibre crops and in the observation of their performance under local conditions. A report on these will appear in a later issue of this *Journal*.

B.E.V.P.—

Botanical Names	Family	Common Names	Uses
A—BAST FIBRE PLANTS, mostly annuals, yielding soft fibres by rettings, soft hemp and chiefly used for textiles—			
1. *Bochmeria nivea* Guad.	Uritcaceae	Ramie, Rameh, Ramio, Rhea. China grass (Perennial and does not ret).	Clothing, millinery, draperies, upholstery, embroidery, gas mantles, etc.
2. *Cannabis sativa* L.	Moraceae	Hemp, Indian or Russian hemp	Thin ropes and cables, nets, canvas, sandal soles, sailcloth, twine for seine nets, sacking, matresses, upholstery, hats and bookbinding, hemp tow for oakum, packing for pumps, caulking boats, etc.
3. *Corchorus capsularis* L.	Tili	Jute (round pod). Gunny fibre.	Sacks for sugar, coffee, grain, stockfeed, fertiliser, wool, sandbags, etc., cheap webbing, nets, cordage.
Corchorus olitorius L.	,,	Jute (long pod). ,,	
4. *Crotalaria juncea* L.	Leguminesae	Sunn hemp. San hemp. Bombay hemp. Jubbulpur jute	Fishing nets and lines, marine cordage, canvas.
5. Hibiscus cannabinus L.	Malvaceae	Deccan hemp. Bombay hemp. Awbari hemp. Bimlipatam jute.	Sacks, cordage.
6. Hibiscus esculentus L.	,,	Okra. Lady's fingers. Gumbo	
7. Hibiscus quinquelobus L.	,,	West African jute. Kowe. Corwey	
8. Hibiscus sabdariffa L. var. altissima.	,,	Roselle hemp. Rama. Sorrel.	
9. *Linum usitatissimum* L.	Linaceae	Flax. Linen. Linseed	Linen. clothing. thread.
10. *Urena lobata* L.	Malvaceae	Cousin mahoe. Cousin rouge. Grand mahot cousin. Aramina fibre. Cadillo. Malva blanca. Bolobolo Toja.	Sacks, Twine.
NOTE.—Many other plants yield soft bast fibres, families Malvaceae, Moraceae, Tiliaceae and Urticaceae especially. Refer. Macmillan, H. F.—" Tropical planting and Gardening ".			
B—LEAF FIBRE PLANTS, mostly perennials, yielding hard fibre by scutching, used chiefly for cordage—			
1. *Agave cantala* Roxb.	Amaryllidaceae	Cantala. Maguey. (Philippines, Java India, Madagascar).	Cordage.
2. *Agave fourcroydes* Lemaire	,,	Henequen. Mexican sisal. White or Cuban Sisal.	Cordage, binder twine.
3. *Agave sisalana* Perrine	,,	Sisal	Ropes, binder twine, some types of marine cordage, coffee and cotton sacks, etc.
4. *Agave funkiana* Koch	,,	Jamauve istle. Jamauve lechuguilla (Mexico).	Brushes.
5. *Agave lecheguilla Torr.*	,,	Lechuguilla. Tampico fibre. Istle. (Mexico).	Cordage, sacks. brushes.
6. *Agave letonae.* F.W.T.	,,	Letona. Salvador-henequen. (El Salvador).	Soft yarns, ropes, coffee and sugar sacks.
7. Ananas comosus (L) Merr.	Bromel	Pineapple hemp.	Fine textile fabrics.
8. Bromelia magdalenae Andre Syn. *Aechmea magdalenae* Syn. *Ananas magdalenae*	,,	Columbia pita, Arghan fibre.	Fine textile fabrics.
9. *Bromelia pinguin*	,,	Pinguin	Fine textile fabrics.
10. *Furcraea gigantea.* vent	Amaryllidaceae	Mauritius hemp. Aloe Piteira. Pita.	Cordage, sugar sacks.
11. *Furcraea Macrophylla.* Baker	,,	Fique (Columbia, Bahamas, Jamaica).	Ropes, hammocks, sacks.
12. *Furcraea andina Trel.*	,,	Choohoo (Ecuador and Peru)	Ropes, halters, sacks.
13. *Furcraea cabuya, Trel.*	,,	Cabuya (Costa Rica and Panama)	Twines, ropes, halters, hammocks.

Botanical Names	Family	Common Names	Uses
14. *Furcraea Humboldtiana. Trel.*	,,	cocuiza (Venezuela)	Ropes, sacks, halters.
15. *Furcraea Hexapetala* (Jacq.)	Urb. ,,	Pitre (Haiti).	Ropes, sacks, halters.
16. Musa textilis. Ne'e	Musaceae	Manila hemp. Abaca fibre.	Good quality ropes and cordage, especially marine cordage, manila paper and tissue paper.
17. *Phormium tenax.* Forest	Liliaceae	New Zealand hemp. New Zealand flax.	Ropes cordage, yarns and fabrics.
18. *Sansevieria zeylanica* Willd.	,,	Bowstring hemp	Twine, bowstring, fine mats.
19. *Sansevierica spp.*	,,		Several other species of sanseviera yield good fibre for twine, ropes and mats.
20. Yucca spp.	,,	.....	Many species of yucca, and also of related genera *Samuela.* Hesperaloe and Hesperoyucca grow in arid conditions are of local importance, yielding a coarse fibre used for twines, ropes, sacks, etc.
C—SEED FIBRE PLANTS (for details refer to lectures on Cotton, and Silk Cotton)—			
1. *Aslepias semilunata*	Asclepiadaceae	.....	Stuffing matresses and pillows.
2. Ceiba pentandra (L) Gaertn.	Bombacaceae	Kapok. silk cotton	Stuffing cushions. life belts, Insulating.
3. Ceiba aesculifolia (H.B.K.) Britt	,,	Pochote	,,
4. Ceiba acuminata (S.Wats) Rose	,,	,,	,,
5. Chorisia insignis Humb.	,,	,,	,,
6. Chorisia speciosa St. Hilaire	,,	.....	,,
7. Gossypium spp.	Malvaceae	Cotton	Textiles.
8. Cocos nucifera L.	Palmae	Coir fibre	Matting, etc.
9. Ochroma pyramidale	Bombacaceae	Bois flot. Corkwood	Stuffing cushions.
D—MISCELLANEOUS FIBRE CROPS.			
(i) PALM LEAF FIBRES.			
1. Attalea funifera	Palmae	Bahia piassava	Brushes, etc.
2. Borassus flabellifer	,,	Palmyra palm	Thatch, olas. matting, baskets, fans.
3. *Calamus spp*	,,	Rattan palms	Canes, chairs, baskets, etc.
4. *Carludovica insignis*	Cyclanthaceae	Panama hat plant. Toquilla straw. Jippi jappa.	Hats, baskets, mats, etc.
5. *Carludovica palmata*	,,	,,	
6. *Dictyosperma fibrosum*	Palmae	Madagascar piassava	Brushes, etc.
7. *Leopoldina piassaba*	,,	Para piassava	Brushes, etc.
8. *Manicaria saccifera*	,,	Timite	Thatching, mats.
9. *Maximiliana caribaea*	,,	Cocorite palm.	Thatching.
10. *Pandanus utilis*	Pandanaceae	Screw pine	Mats, hats, etc.
11. *Phoenix dactylifera*	Palmae	Date palm	Baskets, brooms, etc.
12. *Raphia spp.*	,,	W. African piassava	Brushes, mats, baskets. etc.
13. *Sabal glaucescens*	,,	Carat palm	Thatching.
14. *Sabal umbraculiferum*	,,	Palmetto royal	Mats, hats, baskets.
15. *Thrinax argentea*	,,	Broom palm. Silver thatch palm	Brooms. hats, baskets.
(ii) GRASSES.			
1. *Ampelodesma mauretanica*	Gramineae	Esparato grass	Paper making.
2. *Arundo donax*	,,	Giant reed	Thatching.
3. *Bambusa vulgaris*	,,	Bamboo	Paper making, houses, screens, furniture, pots, etc.
4. *Cyperus payrus*	Cyperaceae	Papyrus	Paper making.
5. *Gynerium sagittatum*	Gramineae	Wild cane. Uva grass. White rosea	Building and thatching.
6. *Oplismenus birtellus*	,,	Ribbon grass	Baskets, etc.
7. *Phragmitea communis*	,,	Common reed. wild cane	Thatching.
8. *Sorghum vulgare var.*	,,	Broom corn	Brooms.
9. *Spartina spp.*	,,	.....	Thatching.
10. *Sporobolus indicus*	,,	Tapia grass, wire grass Mulatto plant.	Tapia work, stuffing.
11. *Stipa tenacissuma*	,,	Esparto grass	Paper making.
12. *Vetiveria zizenoides*	,,	Khus-Khus grass	Mats.
(iii) MISCELLANEOUS.			
1. *Luffa* spp.	Cucurbitaceae	Loofah	Loofahs.
2. *Antiaris toxicaria*	Moraceae	Upas tree. Sack tree	Bark cloth. sacks.
3. *Ficus natalensis*	,,	Bark cloth tree	Bark cloth garments, curtains.

Fig. 1.—Cacao tree, Naduruloulou, 1951, type *Criollo* with white *cotyledons*.
Photo—R. WRIGHT, P.R.O.

CACAO IN FIJI—REVIEW AND PROSPECTS

BY B. E. V. PARHAM

Introduction.

1. For some time, attenion has been directed to the prospects of establishing a cacao industry in Fiji—and the following notes provide a brief review of earlier attempts to grow cacao, information on recent action which has been taken and proposals for a practical research and field programme for the immediate future.

2. It is generally well known that several plantings of cacao were undertaken and abandoned within the period, 1900-1920, that little cacao was ever harvested and that few local planters have shown any interest in the crop—in spite of present high prices and of the fact that some of the major producing areas are threatened by diseases which do not occur in the Pacific.

3. Between 1936 to 1942, the Department attempted to introduce cacao to Fijians as a particularly suitable cash crop for either individual or community effort ;—and in 1944, Professor Shephard (2) reported at some length on the possibility of developing the industry in Fiji, the Solomons and Tonga and recommended a thorough examination of the subject and the introduction of selections from Trinidad.

4. In 1945, Patternson and Dodds (3) supported these proposals and recommended the establishment of trial blocks of I.C.T.A. selections. The subsequent action taken is described below.

5. In the meantime the price of Cacao has remained high. World prospects continue to encourage the planting of cacao in suitable areas and new methods of vegetative propagation have greatly enhanced the rate at which high quality, uniform and self-compatible strains can be multiplied for distribution to planters.

Survey of local sources of plant material.

On account of the two serious diseases of cacao, swollen shoot virus and witch-broom disease—it is impossible to envisage and all the authorities strongly advise against, any large scale introduction of seed or plants from the major cacao producing countries where, of course, many high yielding and desirable types have been selected and bred out during recent years. This fact necessitates action in two directions ; first, an appraisal of all cacao varieties and types growing in the Colony and second, the controlled introduction of limited numbers of improved types under strict quarantine. Some preliminary action has been possible in both these directions.

Early Records.

7. Records show that from 1880 onwards Cacao plants and seeds from various sources were introduced and planted in many parts of the Colony. The first Cacao grown in Fiji appears to have been introduced from Trinidad by J. B. Thurston—(later Governor) about 1880 (Berkeley 1). Fruit of two varieties were harvested in April and September 1886—viz.: " Five-groove yellow Prolific " with 42 seeds per pod and " Sangre Toro " with 40 to 42 seeds per pod. Extant drawings of these fruits enable these varieties to be indentified as *Forastero* type *Amelonado*, and *Criollo* respectively. From these trees, seeds were distributed widely during the ensuing (twenty) years and further introduction most certainly made because there are records of seed of many types being used to establish plantations in various places. During the period 1905-1909, for example, 23 different introductions were made at Nasinu, some were named varieties from India, Singapore, Java and Samoa—others mostly unnamed were from local sources, e.g. Suva, (probably Government House), Lami, Wainunu and Rewa. These latter were no doubt seed from earlier introductions (Appendix II and III). Eight plantations totalling approximately, 200 acres were established at Lami, Wainunu, Savusavu, Taveuni and Macuata—without apparent regard to variety or type: although one called *Red Java* occurs more than once in the record. This is now believed to be a type of *Criollo*—a high quality variety. Knowles (11) writing in 1916 states, however, that " the Cacao grown in Fiji is all *Forastero*.

Fig. 2.—Cacao tree, Naduruloulou, 1951, type *Forastero- Amelonado*.
Photo—R. WRIGHT, P.R.O.

Cacao in Vanua Levu.

8. In 1942 M. D. ffrench Mullen (1) carried out a survey of the surviving plantings in Vanua Levu and Taveuni which originally varied in extent from as few as 12 trees up to plantations of 70 acres. He found cacao trees growing at 11 localities—mostly established between 1900 and 1910. These appear to have been abandoned following a destructive hurricane in 1912 and now aggregate only about 10 acres altogether..

The existing trees were referred to the following types (Van Hall classification):—

Criollo—3 types and one sub-variety (*Porcelaine*).

Forastero—20 types in 4 sub-varieties viz. (*Angoleta, Cundeamor, Amelonado* and *Calabacillo*).

It is believed that, if necessary, some of these old plantings could still be used as sources of supply of plant material ; but considerable research would be required into the varieties and the quality of the beans before selections suitable for large scale propagation could be recommended.

Recent attempts to establish Cacao.

9. During the period 1937-40 the Department of Agriculture endeavoured to revive interest in cacao as a small holder crop ; and seed was obtained from Samoa and from Vanua Levu for planting on various demonstration areas and for distribution to Fijians. These included, in addition to three of the types referred to above, some hybrid seed (*Criollo* and *Forastero* and some pure *Criollo* from Tuanaivuto plantation, N.Z. Reparation Estates, W. Samoa. Records show that attempts to establish Cacao at Sigatoka and in Vanua Levu failed, but at the following places, trees were planted: Naduruloulou 50, Naduna 100, Korovou 8, Waimaro 9. Of these, the only plants avaiable to-day are those at Naduruloulou where 46 trees survive, 15 being now in bearing. A tentative classification of these is as follows (Appendix IV).

Criollo—(Fig. 1).

Criollo x Forastero type Amelonado 1 tree (Figs. 2, 4A, 5A).

Forastero-Angoleta Figs. 4B, 5B).

Forastero-Cundeamor—(Figs. 3, 4B, 5B).

Recent Introductions.

10. During 1948 and 1949 attempts were made to introduce rooted cuttings of the Trinidad selection (Criollo x Forastero) type I.C.S.—7. Two consignments by air freight were received in November 1948 and in May 1949 ; but in spite of careful attention none survived, presumably on account of the cold temperatures at the high altitudes traversed in transit.

In February 1950, four plants of I.C.S. —7 were brought out from Kew by surface vessel and these have been successfully established at Naduruloulou, and are growing strongly (Fig. 6).

In October 1950, one pod of Forastero-type Amelonado was received from Western Samoa but only one plant was raised.

In December 1950, three pods of a high-yielding, disease resistant type " Lafi No. 7 " was received from the N.Z. Reparation Estates, W. Samoa, and from these 43 plants have been raised. This type is described as " a green-red podded Java *Criollo* x *Forastero* hybrid, completely free from *Phytophthora* disease for three successive seasons, a good bearer whose crop ripens in mid-season, every pod has a predominance of white or near white beans and the tree is believed to be self-compatible. Pods have an average of 40 good sized beans." Action is now being taken to obtain from Kew certain other Trinidad selections and a further consignment of I.C.S.—7. It must be repeated here that large scale introductions at least from outside the South Pacific region cannot be attempted because of the danger of introducing the two major diseases, " Witches' Broom " and " Swollen Shoot ". Even through Kew only small consignments should be made. From these by modern methods of vegetative propagation it will be possible to build up in a reasonable time a local supply of planting material of superior quality and uniformity.

At present there are 283 Cacao trees planted out at Naduruloulou, the majority being seedlings from known parent trees. A hedge of the type *Forastero-Amelanado* has been established from which leaf cuttings may later be taken. This type has proved robust in growth under local conditions and yields a good crop of beans. Cer-

tain trees of *Criollo* type as well as the *I.C.S. 7* and *Lafi No. 7* inttroductions are being carefully tended with a view to early vegetative propagation.

One set of eight concrete propagators has been constructed for experimental purposes: if this is successful others will be installed.

Proposals for future action must include provision for serious study of and attention to a number of problems and possibilities. Investigations are necessary on varieties, propagation methods, conditions of growth, diseases and pests and processing technique. Also it will be necessary to consider in advance the problems of the potential growers and their reaction to the demands of a permanent tree crop upon their time, patience and society. This crop requires careful harvesting and uniform processing at proper times and under controlled conditions.

The study of varieties is already begun in a small way. It calls for the collection or introduction, establisment and maintenance of type collections of cacao varieties for observation and comparison.

Propagation work will necessitate experiments with the new methods and techniques which enable large numbers of identical plants to be raised from leaf cuttings taken from selected parents trees. The behaviour under local conditions of new introductions will have to be compared with that of material from types already established in the Colony.

Owning to the abandonment of the infant industry following the hurricane of 1912

Fig. 3.—Cacao tree, Naduruloulou, 1951, type *Forastero-Cundeamor*.
Photo—R. WRIGHT, P.R.O.

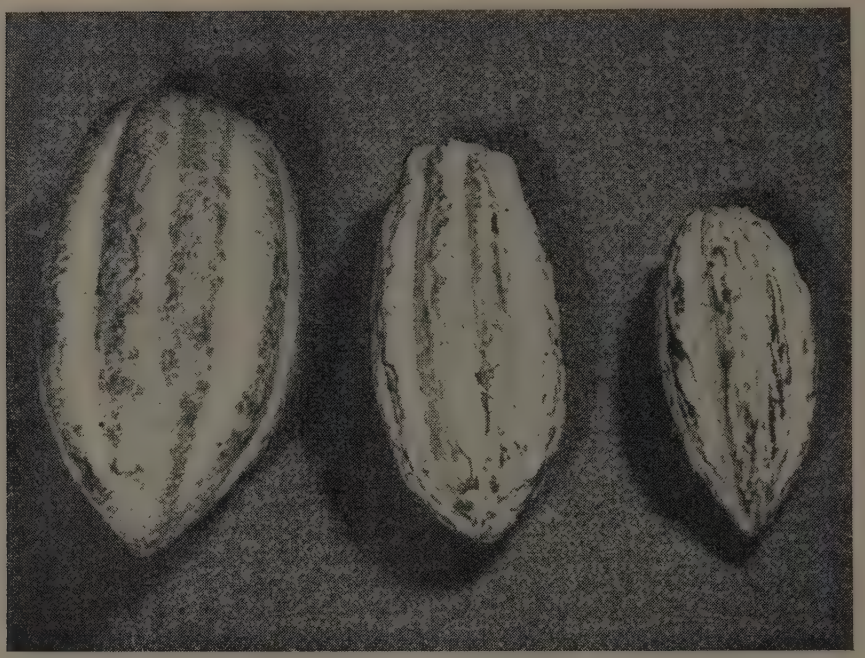

Fig. 4.—Cacao Pods, Naduruloulou, 1951 (*a*) *Amelonado*, (*b*) *Cundeamor*, (*c*) *Angeleto*.

Photo—R. WRIGHT, P.R.O.

little work has been done on this crop and our knowledge of local growth conditions is very inadequate. Careful studies must be made of the soils and climatic conditions most suitable for this tree to grow and bear well. It is believed that there are large areas of land in Viti Levu, Vanua Levu and Taveuni which are quite suitable for cacao culture. Pilot plantings in selected localities will probably be desirable before any large scale planting is attempted. The cacao tree is susceptible to wind damage; but it has great vitality and capacity to recover even after severe damage has been sustained.

Of great importance in my plan to develop a tree crop economy is a study of special problems, social and economic, which may affect the potential grower. The question of land tenure and systems of agriculture call for careful investigation, no less than the pest and diseases which are known to affect the cacao tree.

Fiji, and indeed the whole South Pacific region, is fortunate up to date in as much as two of the most serious diseases do not occur. Control of these diseases which have spread rapidly in cacao areas in West Africa and West Indies is very difficult and expensive, hence every possible precaution must be taken to prevent their introduction to this part of the world. The principal diseases which are already known here are Black pod, *Phyphthora palmivora* But ; Brown root rot (*Fomes noxious* Corner); Collar-rot (*Ustulina zonata* (Lev.) Sacc.); thread-blight (*Marasmius scandens* (Mass.); and pink disease (*Corticium salmonicolor* B. and Br.). The foliage especially of young trees is heavily attacked by the Indian rose beetle (*Adoretus versutus*). Effective control of these pests and diseases are, however, quite possible under local conditions.

Finally on the research side, attention must be given to the harvesting, processing and storage of the cacao beans. Valuable advances in processing techniques have been developed nearby at the New Zealand Reparations Estates in Western Samoa and there is no doubt that these will be adaptable elsewhere.

When the time comes to establish plantations, considerable thought must be given to the selection of suitable areas for cacao culture, to means of distributing plants and cuttings, methods of quarantine and disease control and the training of growers in the care of the trees and later in the methods of harvesting and processing, which must be organised so as to produce economically the grade and quality in bulk consignments which the market demands.

APPENDICES.

I—Existing Cacao Plantings in Fiji—1951.
II—Cacao culture in Fiji, 1905-1923.
III—Record of Cacao Introductions to Departmental Stations 1905-51.
IV—Cacao plantel out at Naduruloulou (1937-1945).
IV—Cacao planted out at Naduruloulou (1937-
VI—Photographs.
VII—References.

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(2) 1944 Shephard, C. Y.—"Report on Agricultural Policy
(3) 1945 Patterson, D. D. & Dodds, K. S.—"Recommendations for Reorganisation of the Department of Agriculture, Fiji," C.P. No. 29, p. 26.
for Fiji and W.P.H.C. Territories," C.P. No. 24, p. 10.

Fig. 5.—Cacao Pods—(*a*) *Amelonado*, (*b*) *Cundeamor*, (*c*) *Angeleto*. Note dark purple *cotyledons*.

Photo—R. WRIGHT, P.R.O.

Fig. 6. -General view Cacao Plot. Naduruloulou, 1951, type I.C.S. 7 with banana and *Erythrina* shade.

Photo—R. WRIGHT, P.R.O.

CACAO.

I—EXISTING CACAO PLANTINGS IN FIJI—1951.

Locality.	*Varieties.*	*Originally Planted* *Acres.*	*Date.*	*Surviving.*
VITI LEVU—				
Lami	Forastero and Criollo ..	23	1902	Few trees.
Suva	Forastero and Criollo ..	..	....	....
Nasinu	Forastero, Java Red, etc.	9½	1906–12	....
Naduruloulou	Criollo (Java Red) ..	..	1944	....
	Criollo × Forastero ..	..	1944	....
	Amelonado	..	1946	....
	Angoleta	..	.....	....
	Cundeamor	..	1946	....
	I.C. S–7	..	1950	....
	Lafi No. 7	..	1950	¼ acre.
VANUA LEVU—				
Nadi	Criollo	2T	1910–13	2 trees.
Valaga	Criollo (80%) Cundeamor	20	1910–12	1
Denua	Criollo	6T	1910	....
Waiwai	Criollo, Cundeamor ..	20	1908–12	....
Waibalabala	Criollo (Java Red) 80%	60	1908	3 acres.
	Angoleta ..		to	
	Cundeamor ..		1912	
	Amelonado ..			
Wainunu	Criollo (Java Red)	70	1912	606 ?
	Porcelaine ..			
	Angoleta			
	Cundeamor ..			
	Amelonado ..			
Sawai	N.S.	1	1910	....
TAVEUNI—				
Mt. Vernon	Amelonado	5	1920	....
ROTUMA—				
Sumi	N.S.	N.S.	N.S.	Few trees.

Vanua Levu 1300 trees (21).
Viti Levu 200 trees.

II—CACAO CULTURE IN FIJI—1950–1923.

(*References and Extracts from reports by C. H. Knowles*).

1. 1887 Berkeley, H. S. Planting Enterprise in Fiji—Past, Present and Future—Suva Govt. Print. p. 7.

2. 1905 Knowles, C. H. Reports on Agriculture. C.P. No. 20.

28th January, LAMI.—Cacao c. 3 years old—15 feet apart—banana shade.

LEVUKA.—Cacao in old Botanic Gardens (p. 15).

WAIMANU.—Cacao Red Java var.—old trees near house—young planting = 70 acres. Pod small, thin-husked, many seeds.

3. 1907 Knowles, C. H. Agriculture Report for year 1906. C.P. No. 13.
Cacao (p. 2) Five vars. in plots ½ acre each with G.M. bananas for shade. Half of each plot with *Erythrina* or *Cassia* shade. Half of each plot manured. Sulp. Amm. ½ lb; Kainit ½ lb; Super ½ lb per tree. Rose beetle doing much damage also boring beetle *Xylopertha Lifuana*—which also attacks *C. nodosa* (p. 7).

4. 1909 ,, Agriculture Report for year 1908. C.P. No. 27.
NASINU.—Cacao area 3 acres costs lining and planting £1 16 3
Shade is G.M. Bananas. Plant shade .. 2 17 6
Supplying .. 0 10 0
Cult Weed, etc. . 28 10 0
Spray 0 2 6
£35 19 9
LAUTOKA.—Cacao many young plants died in dry weather—supplied—*Cassia nodosa* planted as shade.

5. 1910 ,, Agriculture Report for year 1909. C.P. No. 27.
NASINU.—Cacao (p. 3)—All pods used in 1906 for seed were taken from Botanical Gardens, Suva—appear to be *Forastero* but considerable variation. Few plants of Red Java planted. Shipment of Criollo from Samoa failed to germinate. Cacao commenced to flower and a few pods have been obtained (i.e. 3 years). One acre Cacao planted in bush 14 feet apart cost £1 4s. 6d. (p. 3).
LAUTOKA.—Most of Cacao plants dead.

6. 1911 ,, Agriculture Report for year 1910. C.P. No. 23.
NASINU.—Cacao 3 acres planted 14′ × 14′. Forest area (1 acre) planted with seed at stake. Weeding *Mikania* cost £5 1s. 3d., for year.

7. 1912 ,, Agriculture Report for year 1911. C.P. No. 34.
NASINU.—Cacao—considerably extended—seed from earlier plots.

Cost and Revenue—	*Area.*	*Cost.*	*Returns.*
	3·2 acres	£14 0 6	£13 17 0
	3·3 ,,	12 7 0	20 6 3
	3·0 ,,	9 13 0	18 2 9

Forest block expensive, method not recommended.

8. 1912 ,, Annual Report for year 1912. C.P. No. 28.
NASINU.—9½ acres—local vars.

No. 1.	3·2 acres	planted 1907
No. 2.	3·5 ,,	1910
No. 3.	3·0 ,,	1910

9. 1915 ,, Agricultural Annual Report for 1914. C.P. 24.
NASINU.—Cacao area reduced to 2½ acres—Soil unsuitable. Gale damage of December severe. Pods reaped during year 11,003—weight 709 lb. Seed in pulp 161 lb, dried after fermentation 51 lb, 32 pods used for seed purposes. 50 lb stock manure per large tree benefit as good as 4 lb complete mineral manure.

10. 1916 „ Agriculture Annual Report for year 1915. C.P. No. 29.
NASINU.—Cacao plots suffered severely from 1914 hurricane all young pods dropped off—manured in June—2 cwt. Super and 1 cwt. Sulp. Amm. to 2½ acres gave good results. *Thyridaria tarda* Bancroft (attacking pods causing dieback). Brown Rot disease ? *Hymenochaete noxia*. *Corticim lilacoo—fuscum* Berk et Wend. Pink disease *Phytophthora faberi* Mont Black rot.

11. 1916 „ Cacao—Phamphlet No. 17.

12. 1917 „ Department of Agriculture, Annual Report for 1916. C.P. 109.
NASINU.—Cacao reduced from 3 to 2 acres. 1½ acres, manured Sulp. Amm. 1 cwt.; Potash (Kainit) 88 lb; Super 2 cwt. B.a. good response. All pods used as seed. Plot No. 5 (one acre) planted in new land 14′ × 14′. Entomologist refers to Scolid for control of *Adoretus* causing extensive damage—on one estate 3½ tons destroyed.

III—RECORD OF CACAO INTRODUCTION TO DEPARTMENTAL STATIONS 1905–1931.

F.D.A. No.	*Date.*	*Description.*	*Origin.*	*No.*	*Remarks.*
7	1888	Trinidad five groove yellow prolific ..	Trinidad ..	N.S. . ..	At G. House.
	1888	Trinidad Sanga Toro	....	.....	.....
66	31/7/05	N.S.	Wainunu..	20P	Nasinu Plot 5.
69	15/7/05	A Large Yellow	Lami		„
		B Small Yellow	„	98–P . ..	„
		C Large Red	„		
187	15/7/06	Small Yellow	Suva ..	40–P . ..	„
214	13/7/06	A Red	„ ..	30 P . ..	„
		B Large Yellow	„ ..	12–P . ..	„
278	6/8/06	N.S.	Singapore .	13–P . ..	.....
411	4/11/06	Large Yellow (Thin skinned) . ..	Suva ..	100–P ..	„
412	4/11/06	Large Red (Thin skinned)	„ ..	100–P ..	„
423	7/11/06	Small Yellow	„ ..	190–S ..	„
424	„	Small Red	„ ..	Pod–1 ..	„
551	20/4/07	Criollo	Samoa ..	S–468 ..	„
565	7/5/07	N.S.	India ..	P–2	„
741	11/9/07	Mixed	Suva ..	S–106 ..	„
771	12/1/08	Small Red	Rewa ..	N.S. . ..	„
812	22/6/08	Small Yellow	„ ..	N.S. . ..	„
908	8/2/09	Yellow Alligator (Long)	Lami ..	335	„
909	„	Red Alligator (Long)	„ ..	342	Red Java.
910	„	Small Smooth Red	„ ..	Pods–12 ..	„
911	„	Amelonado	„ ..	Pods–12 ..	„
912	„	Small Smooth Yellow	„ ..	Pods–6 ..	„
913	„	N.S.	Baulevu ..	Pods–25 ..	„
960	27/9/09	Forastero (Smooth Yellow)	Rewa ..	Pods–20 ..	„
966	30/9/09	Forastero (Large Red)	Suva ..	Pods–3 ..	„
967	„	Small Yellow	„ ..	Pods–3 ..	Navuso.
	2/11/36	Pure Criollo	N.Z.R.E. Samoa.	Pods–5 ..	Nasinu.
	2/11/36	Forastero × Criollo	N.Z.R.E. Samoa.	Large Pods .	„
	24/2/37	Hybrid	„ ..	Pods . ..	„
	3/10/38	N.S.	Nasinu ..	Pods–8 ..	Korovou.
	„	N.S.	„ ..	Pods–9 ..	Waimaro.
	4/10/38	Red	„ ..	Pods–50 ..	Naduruloulou.
	„	Red	„ ..	„ ..	Naduna.
	„	Yellow	„ ..	„ ..	„
	2/11/39	Nos. 1 and 2	Waiwai ..	Bags–2 ..	Nausori.
	11/12/39	Yellow	Nasinu ..	Pods–30 ..	Naduruloulou.
	31/3/42	.....	N.S. ..	Pods–9 ..	MF–C2.
	„	.....	....	Pods–3 ..	MF–C7B.

	31/3/44	Type A–A (Amelonado)	Savusavu .	S–604 ..	Naduruloulou.
		Type B (Cundeamor)	„ ..	S–232 ..	„
		Type K (Cundeamor)	„ ..	S–587 ..	„
	Jan. 45	P.R. 2282	....	N.S. P/6 ..	Record in register only.
	Feb. 46	N.S.	....	N.S. S/37 ..	Nad'rlu Nursery.
12943	9/11/48	I.C.S.–7	Trinidad v Kew.	P.ants–6 ..	By air failed.
12964	13/10/49	I.C.S.–7	„ ..	„ ..	„
13003	3/6/50	I.C.S.–7	„ ..	„ –4 ..	By surface P.I. & Q.
13142	28/10/50	? Amelonado	Samoa ..	Pods–1 ..	P.I. & Q. 1 Plant.
13182	9/12/50	Lafi No. 7	N.Z.R.E. Samoa.	Pods–3 ..	P.I. & Q. 43 Plants.

CACAO PLANTED AT NADURULOULOU—1941–1951.

Date.	*Plot.*	*No.*	*Var.*	*Origin.*	*Remarks.*
31/3/42	M.F.C. 2	9	NS	NS	.....
	M.F.C. 7B . ..	3	NS	NS	.....
Jan. 1946	M.F.	20	A (Amelonado)	Savusavu ..	.. PR. 2283.
May 1946	M.F.	25	B (Cundeamor)	„	.. P.R. 2284.
June 1950	.....	4	I.C.S.–7	Trinidad v Kew	.. FDA. 13003.
Aug. 1951	.....	25	Lafi, No. 7	W. Samoa ..	.. FDA. 13182.

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ANIMAL HUSBANDRY . . .

GOAT HUSBANDRY

SOME OBSERVATIONS BASED ON THE RESULTS OF THE FIRST EIGHTEEN MONTHS WORK WITH THE GOAT HERD AT SIGATOKA

BY W. J. A. PAYNE, AGRICULTURAL STATION, SIGATOKA

[EDITORIAL NOTE : *In this article the author refers to the use of the Elastrator for the castration of buck kids. This method is a relatively new development and experience of its use in the Colony is limited. In the hands of a skilful operator the knife provides a cheap and satisfactory method of castration but in view of the aversion to the letting of blood on the part of a majority of Indian goat farmers the Elastrator method, if otherwise satisfactory, is likely to have considerable advantages.*]

The total volume and the cost of imported mutton has been rising steadily, so that in 1946 Fiji imported 402,396 pounds costing £17,277, while in 1950 589,633 pounds valued at £35,505 were imported. Goat meat could partially replace mutton and a flourishing goat industry would help to produce meat that would replace costly imports.

Although the number of goats in the Colony is not negligible, being 23,787 at the 1950 census, they are not increasing as there were 26,000 in 1940, and according to reports the average carcass weight in 1947 was half what it was in 1937.

The majority of flocks are small, there is no breeding policy, kid mortality is high and knowledge of goat husbandry generally low.

In June 1950 the Department of Agriculture started a goat breeding project at Sigatoka with the object of breeding a suitable type of meat goat for the Colony and gaining some knowledge of goat husbandry. Sigatoka is a suitable location as there are only 743 goats in the wet zone as against 23,044 in the intermediate and dry zones. The work has progressed so well that it has been thought desirable to publish these notes in the hope that they will prove of some immediate assistance to goat farmers and to others who may be considering the establishment of a goat herd.

Goats are of course valuable milk animals but the work at Sigatoka has only been directed towards the production of a suitable meat goat as the vast majority of goats in the Colony are raised for that purpose.

CHOOSING A SUITABLE BREED.

The majority of goats in Fiji are small and are obviously of very mixed origin but they are acclimatised and any foundation flock should consist almost entirely of Fiji stock.

At Sigatoka it was decided to purchase Fiji does and import bucks from overseas in an effort to improve the size of the local goat. Importers are limited to three choices: either to import a strain of goat primarily bred for milk production such as the British Toggenburg, British Saanen, British Alpine, and Anglo-Nubian, or one bred for hair such as the Angora, or an unimproved tropical goat from India, Africa, or Central America. The third choice is not practicable because of the quarantine regulations, and reports from other tropical countries suggests that the Angora or the Anglo-Nubian may be the most suitable of the breeds available.

The Department of Agriculture have imported two Angora bucks from New Zealand and two British Saanen and one British Toggenburg from Australia. The two Angora bucks are flourishing but the three bucks from Australia died within two months of arrival in the Colony. This was probably due to the fact that they were imported in the hot wet season and it must be emphasised that no animals should be imported at this time of the year from a temperate country.

BREEDING.

One of the most elementary but essential facts to be learnt by the goat farmer in Fiji is that all surplus buck kids must be castrated within a few weeks from birth. Kid bucks are undoubtedly very precocious.

The castration can be done with a knife or with a bloodless castrator but the most suitable method is the elastrator. This is a simple instrument which is used to place a rubber ring around the kid's testicles, which then wither and eventually fall off. It is also cheap and effective.

Fiji does apparently breed all the year round and it is possible to obtain two kid crops each year. It is very desirable that all the does should kid during the same season and so the bucks should normally be kept apart from the doe herd and only placed with them twice a year. At present experience at Sigatoka suggests that the bucks should be placed with the does in November and May, so that the kid crops are dropped in the March-April and September-October periods.

It is also important that the doe kids that are to be kept for breeding, should be allowed to mature before they are served. Doe kids born in September-October should not be served until the following November, and so they must be segregated away from the main breeding flock, and it is essential that this be done when they are three or four months old because if the does are kidding twice a year they should have at least one or two months rest from suckling and at three or four months of age the young kids are quite capable of thriving on the hill pastures.

If all the kids are born in one Season it is possible to give some attention to kidding. It is desirable to bring the does on to the lower slopes of the hills for kidding so that they can be watched individually but the goat breeder should not interfere with kidding unless it is clear that the doe is not behaving naturally.

Farmers who import bucks from the temperate zone may find that at first they are either impotent or sterile. This is to be expected as the length of daylight affects the breeding cycle of goats and importation from a long-short light period environment to one where the light periods are of almost equal length throughout the year inevitably affects the sexual cycle of the animal. Time alone is the healer. After some months the animal becomes acclimatised and will show normal sexual activity. At Sigatoka the two Angora bucks imported in June 1950 were still impotent or sterile in November and December, but they served quite normally in March and April and again in November and December 1951.

The same breeding rules apply to goats as to other domestic animals. If the farmer is breeding from Fiji stock he can pick out his best kids and inbreed or he can buy bucks from other districts. Bucks and does should be selected for rate of growth, body conformation and twinning ability. Experience at Sigatoka has shown (Table 1) that twinning is very desirable as it increases the productivity of the herd very markedly.

TABLE 1

Birth weight and liveweight gain of goats at SIGATOKA, 1952.

	Birth Weight. (lb.)			*Liveweight gain Birth —3 months* (lb.)		
	Singles	*Twins*	*Twins as Singles together*	*Singles*	*Twins*	*Twins as Singles together*
Angora x Fiji Born 24/8—22/9	5.8(12)	5.1(14)	10.3(7)	23.7(11)	20.2(14)	40.4(7)

NOTE.—The numbers in brackets indicate the number of individuals represented by the mean.

As can be seen the liveweight gain of the twins in the first three months of life was almost twice that of the singles. In fact the does had sufficient milk to be able to support the growth of two offspring on the feed available. If the farmer imports bucks from overseas he has a choice of three main breeding policies. He can import bucks continuously, cross then with Fiji does, and sell-off the first-cross progeny, or he can select from the crossbreds and inbreed in an effort to stabilise a new type, or he can use a crisscross method using Fiji bucks one generation and imported bucks the next. There are of course many minor variations on these three breeding themes.

FEEDING.

Observations on the grazing and browsing behaviour of the goats at Sigatoka show that they eat all the palatable grasses and legumes on the station, and in addition they have been seen to eat the following weeds: guava (*Psidium guayava*), sida (*Sida acuta*), prickly solanum (*Solanum torvum*), and blue rattail (*Stachytarpheta mutabilis*). Goats should be run on the rough hill grazings but like other classes of stock they will thrive best if they are rotated. This can be done by intelligent herding. The hill should be heavily stocked at any one time but the herd should be steadily moved over the hill not returning to the same area for a period of

three to four weeks. It is probable that goats do best when they graze and browse together with cattle.

In very wet weather they seek shelter and it may be an advantage to have some reserve supply of fodder grass or silage available, so that they can be fed a supplementary ration if they do not venture out.

HEALTH.

Goat mortality is high in Fiji and it is thought that the major cause is internal parasites. At Sigatoka these internal parasites have been the apparent cause of most deaths and during 1950-51 the Veterinary Division identified in fæcal samples or at post-mortems, tapeworms, flukes, nodule worms, whipworms, hookworms, and coccidia in the goats. Control is exercised by rotation and by drenching with a vermifuge and at Sigatoka the goats are drenched monthly with phenothiazine. This drug does not control all the internal parasites but it appears to control sufficient to allow the animal to thrive under the management conditions at Sigatoka. Phenothiazine is not soluble in water and it may be obtained as a powder or in pellet form: the pellet can be administered with a special "gun", while the powder can be given as a drench either with a bottle or with a special dosing gun. Details of the use of phenothiazine have been published in Veterinary Extension Pamphlet No. 3.

In April 1951 a form of mange due to the mite known as *Psoroptes communis caprae* (goat scab) was found on goats at Sigatoka and identified by the Veterinary Department. This is of some interest as it is apparently the first time that the parasite has been reported in Fiji. These external parasites are readily controlled by gammexane, a strength of one part in 5,000 parts of water being adequate. The goats are now sprayed quaterly with a gammexane suspension, using the pump on an Allen Scythe. This has the additional advantage of controlling other parasites. A mechanical pump is not necessary, as this work can be done equally well with a hand pump, or by dipping the goats in a bath.

A form of footrot is the other major trouble in goats. It can be eliminated entirely but the farmer must have goat proof fences and a foot-bath and virtually no farmers in Fiji have these facilities. At Sigatoka we pare the hooves of the goats monthly and apply an ointment made from bluestone (copper sulphate) and vaseline to the feet of any animals that are affected. Full details on the control of foot-rot can be obtained from the Veterinary Division.

MANAGEMENT.

The first difficulty of a goat farmer is that of devising a method of controlling the goats. At Sigatoka three-strand electric fencing was not effective, and although tethering is a successful method of control on flat land, it is not suitable for hill areas or for "bush" areas as the tethers are easily caught up in quite small twigs and the goats may struggle until they strangle themselves. Eight wire fencing is now being erected but this is of course expensive, though it may be economic in view of the price of goat meat.

The most suitable method of control for the majority of farmers is herding. This is easiest if carried out with dogs and at Sigatoka it has been found that local dogs locally trained are very useful. If good sheep dogs could be imported they might be even more useful.

Goat tethers should not be made of rope but light chain. The chain should be fastened to a collar around the goat's neck and pinned into the ground by an iron peg: there should be several swivels in the chain. Tethered goats should be moved across the field quite systematically and not in a haphazard manner. In the wet season tethered goats require shelter, and they should either be taken to shelter when it rains or small moveable shelters be made and moved with them.

There is no doubt that all goats require shelter from rain and if shelter is available they will rush to it. At Sigatoka an open bure has been erected that will shelter up to two hundred goats, and the capital cost is equivalent to the price realised by two mature does per annum, so that it cannot be said to be an expensive luxury. It would probably be desirable to lay a cement strip under the bure roof but this would add considerably to the cost. Bures of this type can be erected by any goat farmer.

ENTOMOLOGY . . .

ON THE PRESENT POSITION REGARDING THE ASIATIC RHINOCEROS BEETLE IN SAMOA

BY HUBERT W. SIMMONDS, FORMER GOVERNMENT ENTOMOLOGIST, FIJI.

SUMMARY OF PREVIOUS REPORTS AND INVESTIGATIONS

Oryctes rhinoceros, the Asiatic Rhinoceros beetle, was accidentally introduced into Western Samoa in 1910, presumably in packing accompanying rubber or cacao plants imported from Ceylon. It spread with alarming and devastating rapidity, killing large numbers of palms. Since that date it has spread throughout the group, and also reached Wallis Island and Nuitabutabu, having however, by the use of vigorous sanitary methods, been stamped out of the latter island.

In 1912, F. P. Jepson, then Government Entomologist in Fiji, visited Samoa and reported upon the position. (1)

The following year, Dr. K. Friedricks made an extensive tour of the Eastern tropics in search of natural enemies of the pest and also introduced into Samoa the green Muscardine fungus, *Metarrhizum anisopliæ,* which still destroys a few of the grubs. He also suggested the introduction of Hedgehogs and the European mole, *Talpa europa,* into Samoa, and was about to try to obtain the Madagascar Scoliid, *S. oryctophaga,* when the 1914 war put a stop to his efforts. (2)

In 1933 I was seconded to the Administration of Western Samoa to report on the position and to make such suggestions as I was able. (3)

The position then was that although certain agencies of a general character, such as pigs, fowls, centipedes, and possibly, the native rail, *Rallus philippinsis,* together with the muscardine fungus, had reduced the intensity of the attacks, numbers of trees were still being killed by the beetle, whilst the replacement of aged palms, of which there were a considerable number, had become, in some places, almost impossible, and with the death of these old palms, ideal breeding places for the beetle would be provided, necessitating heavy expense to the planter for their destruction.

In 1939 I was asked to undertake a special mission to Java and Malaya to try to ascertain what agencies, if any, tended to check the ravages of the beetle in those countries and, failing to find anything of value, to go on to Madagascar and attempt to bring the Scoliid, *Scolia oryctophaga,* from there. (4) Just prior to sailing word was received that the Dutch had introduced this insect into Java and that they were successfully breeding it upon *O. rhinoceros.* We also received information that *Scolia ruficeps* of Java and Malaya, was a true parasite of the same beetle.

On arrival in Java it was found that whilst *oryctophaga* would undoubtedly breed upon *O. rhinoceros* the pupal period in that country had provd to be so long and irregular that it had not been possible to synchronise emergences to bring about mating, and the colony had in consequence died out.

Whilst we were in Java I had found that the Histerid, *Platylister chinensis,* was a great destroyer of fly maggots and colonies of this predator were successfully shipped to Fiji, Samoa and the Solomons. In all of these countries it did well, and as will be shown later, it is also of value against the Rhinoceros beetle.

Tests were also carried out to see whether there was any truth in the statement that *S. ruficeps* was a parasite of the same beetle. These tests were very definite that, so far as the Javanese *ruficeps* was concerned, this was not the case. Proceeding next to Malaya I went into this matter and the case seemed watertight that *ruficeps* had been bred from *Oryctes,* but the two parasites in question were larger than the normal *ruficeps* of Java and Malaya, being more like specimens which I had seen in the British Museum from Burma. It is suggested that there may be a biological race of *ruficeps* in that country which can and does use *Oryctes* as its host.

I was however interested in another Malayan Scoliid, *Scolia patricialis*, which seemed to offer possibilities, but when tested, whilst it stung both *Oryctes* and another Dynastid beetle, *Xylotrupes gideon*, it did not, in the laboratory, oviposit upon either, and I accepted the information of the local entomologists, that it was a parasite of the latter species and not of *Oryctes*. More recently it has been stated that it was also parasitic upon this last named, but I now find that this statement was based upon similar experience to my own, i.e. that it stung, but did not oviposit upon the *Oryctes* grubs. Even had it done so it does not follow that the larva could develop upon this host, so the position remains as it was, and further investigation is called for. The only other enemies of the beetle observed in Malaya seemed to be vertebrate predators, of a type which could not be suggested for introduction into another country.

Our next move was to Mauritius, to which island colonies of *S. oryctophaga* had been introduced from Madagascar many years earlier. Here I was able to study a long list of records showing the dates when this wasp had been observed and this, combined with the experience of the Javanese entomologists, indicated that a cool check was necessary to bring about synchronization of emergence, so necessary to ensure mating. In the absence of any such marked change in Samoa I did not feel very hopeful for the proposed introduction, even if successfully accomplished. However it was the only parasite then known which would breed upon the beetle, and the trial had to be made.

Leaving my wife in Mauritius to collect there, I crossed to Madagascar, from which country a single air-borne consignment during the season was possible. Two consignments of the parasite were prepared, one being sent by air and the second was to be accompanied by one of us, travelling by sea.

As I was not happy about the possibilities of this parasite, I was much interested in a statement made to me by Moutia, an entomologist on the staff in Mauritius, to the effect that in the Museum at Zanzibar, *Scolia carnifax* was recorded as a parasite of Rhinoceros beetles in that country. As this wasp was also in Mauritius I was able to test it out, when I found that it was in no way interested. The matter was however too important to be overlooked and I arranged that my wife should accompany the seaborne consignment, whilst I stayed a month in Zanzibar to look into the position. However on arrival at that island I realised that owing to the war position it would be impossible to do anything and that it would be wiser to concentrate upon getting those parasites which we had through to their destination. In this we were very successful, two hundred and ten out of the four hundred collected reaching Samoa alive. There was also a single *Elis romani*. Although there is good reason to believe that it did breed one generation, it failed, as anticipated to make good and except that one record, has not ben seen since. Meanwhile, whilst my steamer was in Zanzibar, I visited the Museum when I immediately realised that the supposed *carnifax* was some other species, since identified as *S. ruficornis* and that further investigation would be required. A few females of this wasp were captured and tested out on the steamer. These tests showed that *ruficornis* was indeed a true parasite of the African species of *Oryctes* and further tests with grubs obtained in Singapore indicated that it would probably be capable of using the Asiatic *O. rhinoceros* as its host.

The position then was:—

1. That no true parasite of *Oryctes rhinoceros* was known.

2. That *Scolia oryctophaga* had been shown to be capable of breeding upon this host.

3. That there seemed a watertight case that some biological race of *S. ruficeps* could also use this beetle as its host.

4. That there was good reason to believe that *S. ruficornis* would also be capable of doing so.

5. That the case for *S. patricialis* was unproven and still only a possibility.

Such was the position in 1945.

As it had now become evident that *Scolia oryctophaga* was not going to make good and acting upon my advice, it was decided to try to obtain *S. ruficornis* from Zanzibar, and I was again asked to undertake the work

As there was now a weekly air service to Samoa, either via America or India it had become possible to make a series of small shipments, instead of holding them to make up one or two large consignments.

Acting upon advice received from London and supported by my own judgment, the first shipments were despatched via America but these proved failures, being delayed so long *en route* that, with the exception of the last, all were dead on arrival, one lot disappearing entirely. I therefore changed to the Indian route, and all sent through in this way arrived in excellent condition, so that out of a total of 938 adult females despatched, all captured on the wing and thus being of various ages when shipped, 465 reached Samoa, and this figure includes those lost in the American consignments.

This was excellent, but for a long time the issue was in doubt, a few records that the insect had been seen being discounted. However three years after they had been released and twenty-two miles from the point of liberation, the wasp suddenly appeared in numbers at a compost pit in a cacao plantation. This of course indicated that it must have bred several generations during that period and it is hardly likely that it could have made the twenty-two mile jump in one act, so there must have been breeding places between the point of release and that compost pit. These have as yet, not been discovered, although it is probable that some are still in use.

Some time after this the compost pit was emptied and refilled with fermenting material, so that when I visited the locality at the end of the year, there was no sign of the parasite. The weather at that time was exceedingly wet and sunless, but I did succeed in finding another focus for the wasp, whilst several records of it having been seen elsewhere seemed unimpeachable. Two years later, in July 1951, I was advised that it was back at the old heap in even greater numbers than before, but when I visited Apia at the end of that year there had been a period of exceptional drought and none had been seen for some time. Fortunately there had been rain shortly before I arrived and on each occasion that I visited the heap a few were seen.

SAMOA JANUARY, 1952.

Following the introduction of *Scolia ruficornis* into Western Samoa, the American Administration of the Pelaus, where *Oryctes rhinoceros* had recently gained entrance, obtained colonies of this wasp from Zanzibar and also of *Scolia patricialis* from Malaya, but, as yet, no success seems to have attended their efforts. Such being the case, I was asked by the Pacific Science Board of the National Research Council of the U.S.A. whether I would go to Samoa, there to meet two of their officers who were working upon the pest in that group, in order to investigate the position and to ascertain whether it might be possible to obtain colonies of the parasite from that source instead of the more distant Zanzibar.

I agreed to do this, travelling via Tonga, where I met Inspector Muller, the officer who had so successfully cleared up the pest on Nuitabutabu. This officer informed me that that island was about four miles long by two wide, with a bush clad hill, rising to about 350 feet in the centre. The remainder of the land was low, about one third swamp and the balance coconuts and food crops. The work of cleaning the island consisted of destroying breeding places and trapping, and took just over seven years to accomplish. He informed me that old sand latrines were a favourite and unexpected breeding place for the beetle. Much credit is due to Inspector Muller for this excellent piece of work. I also met the Captain of a schooner which trades to that island and he told me that the beetle has never re-appeared.

I arrived at Apia on New Year's Day, where I met the two officers from the Palaus, who had also arrived that day. In their company daily visits were made to a number of localities, examining compost pits and beetle traps.

The long dry spell had very adversely affected the parasite position, so that it was impossible to judge how numerous they were, or to what extent they had spread. However they were present in small numbers at both of the previous concentration sites and I also obtained satisfactory records of their having been observed over a further area. There is however one factor which, up to date, we have been quite unable to ascertain

—that is where the adult wasps feed. I had endeavoured to do so in Zanzibar without success, and so far have done no better in Samoa.

When examining one of the coconut beetle traps we obtained one of the Histerids introduced against the house-fly. As this seemed to me unlikely to be an accident, I suggested a search next day, and we then found that there was a definite concentration of these beetles (*Platylister chinensis*) and of their larvæ in these places and tests showed that in both stages they readily attacked young first instar *Oryctes* grubs. It was also found that two very small Carabid beetles, found by one of my colleagues at the same time would also do so.

It thus seems that there has developed a considerable environmental pressure upon the beetle, consisting of long established factors, such as pigs, fowls, centipedes, and small Carabidæ and that these have been increased to an, as yet unknown, but definite extent by the introduced Muscardine fungus, the Scoliid and the Histerid, with a possibility that the local rail, which has been seen carrying off a mouse, is also a factor.

Can this pressure be increased ?—I believe that it can. There are, scattered about the world, a very large number of Carabidæ, some large enough to attack a full grown *Oryctes* grub and it seems certain that amongst these there are some which are climatically and environmentally suited to the work.

The present position is that, so far as the big estates are concerned, constant trapping has enabled them to keep the damage down to very small proportions, except where the plantations abutt on to bush or badly kept areas. Generally speaking the damage has progressively become less, but unfortunately no photographs taken twenty or thirty years ago, which could be used for comparison, are available and memory is not sufficinetly reliable. There is no doubt that in certain areas, especially where the palms are dying from old age or lightning, the damage can still be very severe.

I have suggested that further compost heaps be prepared and that when the *Scoliids* are again concentrated in their old haunts, one or two colonies should be transferred to these, always first ascertaining that suitable aged grubs are present at the time.

I have also suggested the palnting of certain annual flowers at the present pit sites in order to try to ascertain whether any is suitable for food for the adult wasps. There is no doubt that so far as *Scolia ruficornis* is concerned its final numbers will be controlled by the abundance and accessibility of its host and by the presence of sufficient nectar producing flowers.

During these visits to Samoa no sign has been seen of the Malayan Carabid, *Catascopus facialis*, introduced by myself, in 1939.

ERRATA.

Vol. 23 *No.* 1 *March,* 1952.

" On page 18 column 2 line 12, please read Black Scour worm instead of Black Scar."

" On page 22 at the top of the quantity column, please read tons instead of lbs."

" On page 13 before (*a*) in column 2, please read: " The symptoms observed fall into three main classifications:—

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VETERINARY . . .

ANIMAL QUARANTINE

(CONTRIBUTED BY OFFICERS OF THE VETERINARY DIVISION.)

This Colony is unique in that it has few diseases in its livestock which are considered really devastating to the animal industry. We have no foot and mouth disease, rinderpest, piroplasmosis (red water), contagious pleuro-pneumonia in our cattle, no swine fever among our pigs, no equine anæmia or encephalitis in our horses and we are free of rabies in our dogs.

These happy circumstances are not brought about by chance. In point of fact, climatic conditions such as moisture and humidity are particularly favourable to the spread of most animal diseases. The *status quo* is preserved by means of a strict control on the introduction of all kinds of stock to the Colony. The instrument for this system of policing is the Animals Importation Ordinance.

In this legislation it is providede that a permit must be sought before introducing livestock. It is also set down that certain animals are prohibited from particular countries and the lands are those in which the real stock scourges exist. From other places, stock are permitted under specified conditions only and in all instances they require veterinary inspection and cleansing at the port of embarkation. In addition, dependent upon the country of origin and the type of disease existing there, varying periods of quarantine are instituted upon arrival of the animals in the Colony.

Except in rare cases, air transport of stock to the Colony is prohibited. This is because the brevity of an airtrip does not permit a sufficiently long period of travel which would cover the incubation period of many animal diseases. In most instances surface transport allows for this and the time in quarantine upon arrival is formulated on length of surface transport.

In this Colony, a seven acre station is provided for the purpose of holding stock for observation upon arrival. Provision is made for cattle, horses, goats, sheep, pigs, poultry and for the small animals, dogs and cats. The station is double fenced, subdivided into nine paddocks in which there is a splendid blue-grass sward. Stables for the larger stock and kennels for small animals are provided. The station has a round-the-clock attendant in residence.

Few countries with an animal population as large as in this Colony can boast such comparative freedom from stock diseases. Constant vigilance is the only means by which this happy condition can be maintained.